GROWTH ON THE LONG PRAIRIE UNIT

KLAMATH INDIAN RESERVATION, OREGON

By
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Forester

1947

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TABLE OF CONTENTS

		Page
1.	Timber Cruise Report (1946 - 1947)	1
2.	Permanent Growth Plot #2 Established	2
3.	Measured Growth vs. Calculated Growth (1928 - 1947)	5
4.	Appendix	
	Table 1. Area Basis of Reserve Stand Stock Table	
	Table 2. Volume in reserve stand by diameter and Keen's tree class 1947	
	Table 3. Growth plot #2 volume per acre by diameter and Keen's tree class, 1947	
	Table 4. Growth plot #2 volume per acre by diameter and Keen tree class projected back to 1928	
	Table No. 5 Growth plot #2 stand table 1947	
	Table No. 6 Growth plot #2 stand table 1928	
	Map I Area Cruised	

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REPORT ON TIMBER CRUISE AND PONDEROSA PINE GROWTH STUDY LONG PRAIRIE UNIT, KLAMATH INDIAN RESERVATION, OREGON

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During the winter of 1946 and spring of 1947 an area comprising 16,520 acres of cut-over ponderosa pine timberland was cruised on the Klamath Indian Reservation by the forestry personnel. This total as shown in Table 1 was reduced by 15.2% for open areas totaling 2,520 acres to a net area of 14,000 acres of timber. As this cruise was conducted on the basis of 20% of the area, tree diameters above 11.6" inches and log lengths of 2 and above were tallied on 2800 acres of cruise strip line. All trees were tallied following Keen's classification by age and vigor.

Ninety percent (90%) of the area cruised was in the Long Prairie Unit and ten percent (10%) in the South Calimus Unit. Forty-one percent (41%) of the area was cut over between the years 1924 - 1937 inclusive, while the remaining fifty-nine percent (59%) was cut during the period 1938 - 1944 inclusive. This is shown by Table 1 which gives the gross area of forested land cut over by years and units.

From the data secured on this cruise a stock table, Table No. 2 was constructed. The stock table represents the volume by age, vigor and diameter classes on an acre which is the arithmetical average of the 2800 acres actually cruised. The volume for the average acre was found to be 3800 feet B. M.

This stock table shows a considerable volume in tree classes which would have been cut under the present Klamath marking rules (set up in 1937). This is particularly true of tree classes 3B above 34" D.B.H., 3C above 22" D.B.H., all of 3D, and all of classes 4B, 4C and 4D.

The classes which should have been cut represent a volume of approximately 925 feet B. M. per acre or 24% of the total reserve stand. The presence of large numbers of trees in the reserve stands of the area cruised which fall under the above classes is susceptible of several explanations. Nearly half the area was cut before the advent of the present marking rules; probably a considerable amount of degrade in tree classification as well as growth occurred in the period since cutting; many individuals otherwise cut were left to fill openings in the stand; and finally, the human element factor when operating in the classification of trees falling on the line between tree classes such as 4B and 3B for example might affect the results by throwing too many of the line trees in the oldest age group.

Considering the amount of timbered acreage involved, and the site quality for the cruise area which is a high Site IV, generally considered the average for the reservation, we feel that the stock table compiled as Table No. 2 shows a fairly representative stand for the unit.

Having determined how the average reserve stand in the Long Prairie Unit is made up by means of the stock table the problem remained to find a small area in the unit to be used as a permanent growth plot which would serve as a sample of average growth conditions, neither too well nor too poorly stocked and typical of the stand on a large area adjoining the plot. The sample plot as finally decided upon contains five acres, located in the NW¼ NW¼ Section 3, Township 34 South, Range 9 East, W.M. The plot has a western exposure with about a 10% slope. The reserve stand is located in small clumps, characteristic of ponderosa pine stands with a promising open stand of saplings and immature trees occupying about 40% of the area where no mature trees are found.

The sample plot area was cut over in 1928. In selecting the sample plot for growth measurements care was also exercised to pick out a stand which would approximate as near as possible not only the average reserve stand in volume but more particularly the volume percentage relationship between Keen's four age classes. The site index of the sample plot was found to be 83, making the site quality a high site IV.

The stock table compiled for this sample plot is shown in Table 3. The following comparison of the volume in one age class in the average reserve stand as represented by Table 2 to the volume in the comparable age class on the sample plot as represented by Table 3 shows as close similarity as could be desired, particularly since the average reserve stand contains more volume in age Class 4 than is contemplated by our present marking rules.

Percent of Total Volume by Keen's Age Class

	Age Class				Volume in Bd. Ft.	
	1	2	3	4	By Log Lengths	By total Height
	Percent					
Average Reserve Stand	5.6	41.7	45.5	9.2	3800	———
Sample Plot Stand	1.5	50.2	48.3	0.0	3916	4201

Volumes on the sample plot were computed by two methods, i.e. employing the use of both log length and total height volume tables.

Since the trees on the cruise strips were tallied by log lengths and the volumes computed from log length volume tables (Table 38 U.S.D.A. Technical Bulletin No. 407) the same method of log length measurement and tally was practiced on the sample plot, likewise the same volume computation. However, as height increase plays an important part along with diameter increase in volume growth the sample plot volume was also computed from a table (Table 32 U. S. D. A. Technical Bulletin No. 407) based on diameters at breast height and total heights. Use of the latter table produces a total volume for the sample plot (4201) board feet) which is closer to the amount (3916 board feet) derived from Table 38 than would be produced by the use of any other total height volume table available. Future growth measurements will have to be made on the basis

of total heights requiring the use of volumes computed on this basis.

As shown by the above comparison, the sample plot stand has the larger volume by 116 board feet (3%) compared to the average reserve stand when computed by log length volume tables and 401 board feet (10.7%) when computed by total height tables. However, even the effect of the larger discrepancy (401 board feet in volume) results in such a small increase (3 board feet per acre per annum) in the growth rate during a cutting cycle of 60 years that the two stands may be considered equal in volume for growth prediction purposes.

All measurements were made on the sample plot in 1947 before the growth season had begun. Total heights of all trees were projected back to 1928 by interpolating for site index 83, employing a curve of total heights based on age which is shown as Figure 2 in U. S. D. A. Bulletin No. 407.

Volumes of trees whose heights fell between the ten foot height classes of volume Table 32 were derived by interpolation.

According to Dr. W. H. Meyer (U. S. D. A. Technical Bulletin No. 407) "thorough investigation of the influence of each tree class and of groups of tree classes upon the rate of growth of the stand has shown that the percentages of basal area contained in tree classes 1 and 2 (Dunning) on the one hand and in tree class 3 on the other exert the most powerful influence upon volume growth next to site quality and total volume of the reserve stand."

This relationship or structure as it is termed was determined to be 47-10 for the average reserve stand while that of the sample plot changed from a projected 57-15 in 1928 to the ratio 65-12 in 1947.

Following Dr. Meyer's method of growth prediction we find that the average stand's structure of 47-10 in 1947 will have the same influence on gross growth over a 60 year growth period as the structure 57-15 has had since 1928 on the sample plot's gross growth.

Since the saw timber volumes for the average reserve stand on the Long Prairie Unit and the sample plot are for all practical purposes equal and the effects of their structures on growth being identical we should expect then that the sample plot's rate of growth for the 18 years (1929-1946 inclusive) should be maintained by the unit's average reserve stand for the remainder of the first cutting cycle. That is, if normal mortality had occurred on the sample plot during the period. This of course would have had the effect of reducing the net growth on the plot.

The mortality as found on the five acre plot, however, consisted of but one tree with a volume of 64 feet B. M.; compared to the 700 feet B. M. of mortality which local investigation indicates as normal for the plot (10% of the gross growth) the existent mortality was less than one-tenth of that amount.

The net annual growth on the sample plot was found to be 78.8 board feet per acre over the 18 year period. When checked against the growth (50.1 board feet) predicted for the sample plot following the method devised by P. A. Briegleb (Calculating The Growth of Ponderosa Pine Forests) the actual growth exceeds the predicted growth by 57 percent.

The calculation of growth on the sample plot by Briegleb's method follows:

SAMPLE PLOT GROWTH PREDICTION (BRIEGLEB)

Volume (1928)	2783 Bd. Ft. per acre
Uncorrected gross annual growth	23.68 Bd. Ft. per acre
Correction factor (from alinement chart)	173%
Corrected gross annual growth (1.73 x28.84)	49.89 Bd. Ft. per acre
Actual pole volume growth	4.30 " " " "
Total gross annual growth	54.19 " " " "
Saw timber mortality	4.08 " " " "
Estimated net annual growth	50.11 " " " "

In determining the correction factor from an alinement chart for the above calculation it was necessary to estimate what percent of the virgin stand volume remained in the reserve stand after the first cut.

In the application of the alinement chart the percent of the volume held in reserve produces an inverse effect on the value of the correction factor, i.e. the larger the percent of reserve volume the smaller the correction factor which will be read from the chart. Conversely, the smaller the percent of reserve volume the larger the correction factor.

Since there is no way of calculating the volume of the virgin stand cut in 1928 it was estimated that 60% of the volume was removed leaving 40% of the volume in reserve.

Assuming a reserve volume of 30% of the original virgin stand instead of the 40% used, the correction factor would have been 180% instead of 173%, increasing the net annual growth by only 2.0 board feet per annum. The trees on the sample plot were not considered to have changed their vigor class during the 18 year growth period.

The actual volume of pole growth was substituted in the calculation for the lengthy computations entailed following Briegleb's technique. The pole stand table indicates that the actual growth exceeds the growth that would be derived from the technique.

The total volume growth during the 18 year period is calculated for the five acre sample plot as follows:

MEASURED GROWTH (1929 - 1946 INCLUSIVE)

Initial Volume (1928)	13,917 Bd. Ft.
Pole Growth	387 " "
Saw Timber Volume Growth	6,622 " "
Total Volume (1947)	21,006 " "

Net Volume Growth $\frac{21,006 - 13,917}{5 \times 18}$ = 78.8 Bd. Ft. per acre per annum

From the difference (28.7 board feet) between the growth predicted for the sample plot during the eighteen year period by Briegleb's method and the measured growth it is apparent that this method does not work out satisfactorily for stands as heavily cut as those of the Klamath reservation.

To check the usefulness of Dr. Meyer's method for Klamath conditions it also was applied to the sample data.

SAMPLE PLOT GROWTH PREDICTION (MEYER)

Reserve stand volume (1928)	2783 Board Feet per acre
Structure (1928)	57-15
Growth period	18 years
Gross Yield after 18 years	4140 Board feet per acre
Correction for structure & growth period	104 percent
Corrected gross yield	4306 Board feet per acre
Pole Condition	Average
Total gross increment	1506 Board feet per acre
Mortality deduction (15%)	226 " " " "
Net increment	1280 " " " "
Average net annual increment	71.1 " " " "

The above computation indicates that Dr. Meyer's method yields the closest results to the measured when applied to the Klamath average reserve stands of pure ponderosa pine on high Site IV areas.

If the annual mortality (15% of the gross increment) which Meyer considers as normal for reserve stands had occurred on the sample plot during the growth period under study the net volume increment would, as a result, have totaled 57.0 board feet per acre per annum or slightly under the 71.1 board feet total derived from the calculations following Meyer's method.

Data compiled on mortality for the Klamath area by the foresters of The Weyerhaeuser Timber Company places local annual mortality at about 10% of the gross increment. When this percentage is applied against the measured increment the resulting net increment of 70.9 board feet is remarkably close to the 71.1 board feet derived from Meyer's method.

Fairly heavy mortality is to be expected among the bark beetle susceptible classes which Table No. 2 shows to be present in considerable volume on the area on which the table is based. In anticipation of this mortality before a second cut will be made, due regard for caution in estimating yields for the Long Prairie Unit should make the measured volume growth appear on the optimistic side until further measurements are made at five-year intervals in the future.

Measured growth (1929 - 1946)	78.8 Board feet per acre per annum
Estimated Growth (after Briegleb)	50.1 " " " " " "
Estimated Growth (after Meyer)	71.1 " " " " " "

TABLE NO. 1

AREA BASIS OF STOCK TABLE NO. 2

KLAMATH INDIAN RESERVATION

Unit	Year Cut	Gross Area Cruised Acres	o/o of Total Gross Acreage
Long Prairie	1924	80	
" "	1925	160	1
" "	1926	120	1
" "	1927	160	1
" "	1928	320	2
" "	1929	1040	6
" "	1933	140	1
" "	1934	480	3
" "	1935	380	2
" "	1936	1980	12
" "	1937	2010	12
" "	1938	160	1
" "	1939	1730	11
" "	1941	6090	37
South Calimus	1944	1620	10
		16520	100

Gross cruise area reduced by open areas comprising 15.2% of the total to a net area of 14,000 acres of timberland.

TABLE NO. 2

KLAMATH INDIAN RESERVATION

PONDEROSA PINE STOCK TABLE FOR AVERAGE SAW-TIMBER RESERVE STAND

GIVING VOLUME PER ACRE BY DIAMETER AND TREE CLASS*

1947

TREE CLASSES

	1				2				3				4				Totals	
D.B.H.	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	VOL.	o/o
									Volume - Board Feet									
12	8	10	6	1	1	5	6	2									57	1.0
14	14	18	9	1	4	12	21	8				3					90	2.4
16	17	23	11	1	7	29	50	10		1	5	2					157	4.1
18	18	22	8		14	61	62	9	1	6	21	6				1	229	6.0
20	17	19			22	102	79	8	3	18	35	5				2	307	8.1
22	12				31	134	80		5	32	46	14			1	2	348	9.1
24					52	177	76		12	61	54	11	2		6	2	463	12.2
26					43	146	46		20	98	76	10	1	6	8	2	457	12.0
28					32	113			26	79	10[illegible]	6	3	13	10	1	395	10.4
30					35	77			33	139	81	7	8	22	20	2	424	11.2
32					27				29	168	52		7	34	14	7	337	8.9
34									28	112	20		9	31	16	3	219	5.8
36									36	65	15		10	25	5	5	159	4.2
38									20	33	6		6	18	4	3	90	2.4
40									12	18			6	11	5	2	54	1.4
42									2	5			4	4	2		17	0.4
44									2	4			4	5	2		17	0.4
Totals	86	92	34	3	268	854	420	57	230	836	524	54	60	169	91	32	3800	100.
Per cent	2.3	2.4	0.9	0.0	7.1	22.5	11.1	1.0	6.0	22.0	13.8	1.7	1.6	4.4	2.4	.8	100.0	
Total Vol.		2.5				1579				1654				352			3800	
Percent		(0.0%)				(41.7%)				(43.5%)				(9.2%)				

* Based on Tree Volumes on 2800 Acres of Average Site IV

TABLE NO. 3

KLAMATH INDIAN RESERVATION

PONDEROSA PINE STOCK TABLE FOR PERMANENT SAMPLE PLOT NO. 2

giving volume per acre by diameter and tree CLASS

1947

D.B.H.	TREE CLASSES								
	1	2			3			TOTALS	
	B	A	B	C	A	B	C	Board Feet Volume From Total Ht. Table	PERCENT
	Volume Board Feet								
12	6		8	7				21	0.5
14	38		18					56	1.3
16	21		55					76	1.8
18		30		78			57	165	3.9
20			62	123				185	4.4
22		48	79	157				284	6.8
24			122					122	2.9
26		125	271			124		520	12.4
28		366	330			377		1073	25.5
30			233					233	5.6
32						327		327	7.8
34					376	356		732	17.4
36					407			407	9.7
Volume Totals	65	569	1178	365	783	1184	57	4201	100.0
"	65		2112			2024		4201	
Percent	1.5	13.5	28.0	8.7	18.6	28.4	1.3		100.0
"	1.5		50.2			48.3			100.0

Above stand marked as for comparatively low beetle hazard
This accounts for large volume in BB class above 30" in diameter
Trees were actually "life trees" but fell into 3 class by ring count.

TABLE NO. 4

Klamath Indian Reservation

PONDEROSA PINE STOCK TABLE FOR PERMANENT SAMPLE PLOT NO. 2

GIVING VOLUME PER ACRE BY DIAMETER AND TREE CLASS

Projected Back to 1928 by Increment Measurements

* * *

D.B.H.	TREE CLASSES								
	1	2			3			TOTALS	
	B	A	B	C	A	B	C	Board Feet Volume From Total Height Table	PERCENT
			Volume Board Feet						
12	5		20					25	0.9
14				31				31	1.1
16		11		12			40	63	2.3
18		23	144	89				306	11.0
20			74	94				168	6.0
22		179	92					271	9.7
24			94			98		192	6.9
26			265			176		441	15.8
28						399		399	14.4
30					286	286		572	20.6
32					315			315	11.3
Volume Totals	5	263	689	226	601	959	40	2783	100.0
"	5		1178			1600		2783	
Percent	.2	9.4	24.8	8.1	21.6	34.5	1.4		100.0
"	.2		42.3			57.5			100.0

TABLE NO. 5

KLAMATH INDIAN RESERVATION

PONDEROSA PINE STAND TABLE

D. B. H. Outside Bark

1947

D.B.H. Inches	TREE CLASS									
	1			2			3			
	A	B	C	A	B	C	A	B	C	Total
				Number of trees per acre						
4	2.0	1.0	.4							3.4
6	1.0	1.6								2.6
8	.6	.8	.4							1.6
10					.2					.2
12	.2	.2			.2	.2				.8
14		.8			.2					1.0
16		.2			.4					.6
18				.2		.4			.2	.8
20					.2	.4				.6
22				.2	.2	.4				.8
24					.4					.4
26				.2	.4			.2		.8
28				.4	.2			.4		1.0
30					.2			.2		.4
32										
34							.4	.2		.6
Total	3.8	4.4	.8	1.0	3.6	1.4	.4	1.0	.2	15.6

TABLE NO. 6

KLAMATH INDIAN RESERVATION

PONDEROSA PINE STAND TABLE

Projected Back to 1928 by Increment Measurements

1947

D.B.H. Inches	TREE CLASS									Total
	1			2			3			
	A	B	C	A	B	C	A	B	C	
	Number of trees per acre									
4	.6	.6	.4							1.4
6					.2	.2				.4
8		.6			.2					.8
10	.2	.6	.2		.2					1.2
12		.2			.4					.6
14						.2				.2
16				.2		.2			.2	.6
18				.4	.6	.4				1.4
20					.2	.4				.6
22				.4	.2					.6
24					.2			.2		.4
26					.4			.2		.6
28								.4		.4
30							.2	.2		.4
32							.2			.2
34										
Total	.8	2.0	.6	1.0	2.6	1.4	.4	1.0	.2	10.0